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Pest Control

IN COMMERCIAL FRUIT PLANTINGS

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CIRCULAR 821

Contents

To keep up-to-date . . .

Tune in on W-I-L-L, the University of Illinois radio station (580 on your dial) each Monday noon. The Illinois Farm Hour will give the latest information on controlling orchard pests. Many other stations have similar programs. Consult your local station, your farm adviser, or the Illinois Agricultural Experiment Station, Urbana, for details.

The Spray Service Report, a weekly release giving the same information as the radio programs, is also available to Illinois orchardists. If you want to receive it each week, send $1.50 to the Illinois Agricultural Extension Service, Mumford Hall, Urbana, to cover first-class mailing. (Either stamps or checks payable to the University of Illinois are acceptable.)

These reports are prepared by the agricultural experiment stations of Indiana, Kentucky, and Illinois, the Kentucky State Horticultural Society, the Federal Deciduous Fruit Insect Laboratory at Vincennes, Indiana, and the Illinois State Natural History Survey.

Urbana, Illinois May, 1960

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PEST CONTROL

In Commercial Fruit Plantings[1]

THE BATTLE against insects, diseases, and other pests in Illinois orchards must be fought every year. To help in the fight, various experimental agencies are constantly working out better methods of pest control. This circular brings together the latest recommendations from the Illinois, Kentucky, and Indiana Experiment Stations, the Illinois Natural History Survey, and the U. S. Department of Agriculture. You may need to adjust these recommendations to suit your own conditions — *but don't experiment with untested materials and methods.* To do so may mean disaster.

Pest-control measures are so closely linked with other operations that they cannot be easily separated. This circular therefore includes the practices recommended for quality fruit — not just adequate pest control. For efficient operation, orchard practices must be well organized. So you are urged to study the following pages carefully in order to cope better with the many problems that face you as a specialist in agriculture.

SOME BASIC STEPS IN PEST CONTROL

Continue Sanitation Practices

With the general use of organic insecticides and fungicides and with the increased cost of hand labor, many growers are omitting sanitation practices. This, however, is definitely a mistake. It is practically impossible to secure a high-quality crop when one depends entirely upon chemical treatments. So if at all possible, the following practices should be observed.

For codling moth control

1. If possible remove all wormy fruit and destroy. Examine the top third of the tree closely at the end of the first brood, to evaluate the numbers of larvae that have entered the fruit.

2. Avoid mulching material coarse enough for a larva to spin a cocoon.

[1] By DWIGHT POWELL, Professor of Plant Pathology, University of Illinois; RONALD K. MEYER, Associate Entomologist, Illinois State Natural History Survey; and FRANK W. OWEN, Extension Specialist in Fruit Crops.

3. Store orchard crates and used baskets in a closed building or at least 5 miles from the orchard. Screen the packing shed if it is near the orchard. These measures keep the adult moths from returning to the orchard the next season.

4. Collect and burn all prunings and other debris. Destroy broken crates and baskets, discarded sacks, weed stems, corn stalks, etc.

5. Store props in a closed building or chemically treat them before the next season.

For disease control

1. Collect and remove infected fruit.

2. Prune out fireblight infections as they appear, cutting 4 to 6 inches below the last point of visible infection.

3. Remove all dropped fruit from the orchard at regular intervals.

4. Remove all pruned wood from the orchard and burn. Do not chop up and leave under the trees.

Pruning Is Very Important

Good pruning is of the greatest importance in good orcharding. A definite annual pruning program will make healthy trees.

For one thing, good pruning is an aid in sanitation. Twigs that have been killed by blight or breakage should be removed to help

Tops of high trees should be lowered for convenience in spraying and harvesting. Fruit trees should not be allowed to grow more than about 20 feet high. If trees are already too tall, cut leaders back to horizontal lateral branches (*see arrows*). Too-heavy cutting exposing too much of the top to the sun, may cause branches to sunscald. Light pruning, when the tree first begins to grow too high, is much better. (Fig. 1)

control Botryosphaeria, frog-eye leaf spot, and black rot. Also, fire-blight infections may be reduced by pruning blighted twigs and cankers. Lateral branches should be cut back so that long tips do not extend beyond the periphery of the tree. Such tips are hard to spray and easily become infected with scab. Thus, they may be a source of spores for secondary infection.

Good pruning is a help in spraying as well as in sanitation. If branches are thinned out and the height of tall trees is reduced (Fig. 1) it is easier to get good coverage of the trees with spray material — and less spray is needed. As already suggested, cutting back lateral branches will also make spraying easier. Such pruning is especially worth while in orchards where spraying is done by the nonstop system. It also appears to be of utmost importance in securing maximum efficiency of concentrate sprays.

Other advantages of good pruning are that it reduces the amount of spray required for thorough coverage of each tree and cuts down fruit-thinning costs.

You can save a lot of pruning time by removing water sprouts with a gloved hand in the early summer. At this period of the year water sprouts up to 12 inches long can be rubbed off a mature tree in a short time.

It Pays to Fertilize

For adequate production and good fruit, trees must be in a good state of vigor. Vigorous trees are far less likely to be attacked by insects and disease-producing organisms than are less thrifty trees. And if they are injured they will recover more rapidly and completely. Trees not in good vigor may be completely destroyed by what are normally considered minor pests.

There are no hard-and-fast rules for fertilizing the orchard. It is, however, important to fertilize every year and to maintain a soil-fertility level high enough to support a vigorous cover crop on the orchard floor.

Many growers apply only nitrogen fertilizers. Others use complete fertilizers, applying enough that the soil receives an adequate supply of nitrogen.

The optimum amount of nitrogen to apply will vary with differences in soils and soil management systems. Soils low in organic matter will require more nitrogen than those that are high in organic matter. Orchards kept in sod the year round will generally need more nitrogen than those that are clean-cultivated during the growing season. Too much nitrogen will harm the finish and color of the fruit.

In general, the approximate rate for young trees is 1.3 ounces of actual nitrogen per year of tree age. A 1-year-old tree should receive ¼ pound of ammonium nitrate (33 percent actual nitrogen) or about ½ pound of sodium nitrate (16 percent actual nitrogen). By the time a tree is mature it should be receiving 1 to 2 pounds a year. Trees more than 25 years old should not receive more than 2 pounds.

Soil tests are useful in determining whether a soil needs phosphorus, potassium, or lime, and, if so, how much. These elements have a definite place in many orchard fertility programs, although apples and peaches don't require such large amounts as do field crops.

Many Illinois orchard soils are highly acid. This acidity is apparently responsible for toxic concentrations of manganese in the soil, which severely injure some apple and peach trees. Where soils have pH readings below 5.5, liming should be considered.

Soils testing low in phosphorus or potassium should receive enough fertilizer to raise the phosphorus and potassium levels at least to medium.

For information on how to sample your soil and get it tested, write to the Department of Horticulture, University of Illinois, Urbana.

Don't Neglect to Thin Your Fruit

Chemical thinning of fruit trees is becoming increasingly important, since high labor costs make hand thinning almost prohibitive in commercial orchards. However, chemical sprays must be used with caution. Results will vary with variety, tree vigor, time of application, weather conditions, and concentration of material used. The gallonage applied is also of major importance, making it necessary for each grower to work out a program with his own spray equipment. The following suggestions are made for the guidance of those who want to use chemicals for thinning.

Materials for apples

Hormones are more practical than dinitro materials because thinning may be done after bloom, when the set can be determined and there is little danger of further thinning by late frosts.

When heavy set is expected, use *naphthaleneacetic acid* (NAA) hormones as follows:

1. Apply at calyx or 1 week after. Fruit cracking may result on Transparent and Duchess if thinning sprays are made later than 2 or 3 days after calyx.

2. For Golden Delicious, Transparent, Rome, and Wealthy, use a concentration of 20 parts per million (double the strength recommended by the manufacturers for preharvest sprays).

3. For Grimes, Duchess, and York, use 15 parts per million (1½ times the concentration for preharvest sprays).

4. For Jonathan, Delicious, and Winesap, use 10 parts per million (same concentration as for preharvest sprays) about 1 week after calyx.

5. Remember that it is very easy to over-thin trees low in vigor.

Tween 20 (a proprietary wetting agent), when added to NAA, increases the amount that is absorbed by the plant tissue. This both enhances the effectiveness of the NAA and makes the thinning more uniform. Recommended rate for Tween 20 is ¾ pint in 100 gallons of water. When it is used, the concentration of NAA should be only ⅓ to ½ as great as usual. Caution is urged in the use of this combination, until it has been tried more extensively on an experimental basis.

Transparent is particularly susceptible to flagging of foliage by NAA. Therefore, *naphthyl acetamide* (Amid-Thin), which flags the foliage much less than NAA, is suggested for trial on this variety. Tests indicate that the amount to use varies in different years. Concentrations of 50 to 60 parts per million near petal-fall are suggested.

Materials for peaches

Best results on peaches have been obtained with *naphthaleneacetic acid* formulations. Use them as follows:

1. Apply 2 weeks after shucks are off. Determine this period as accurately as possible. The thinning spray will be less effective if applied a week too soon or a week too late.

2. For Elberta, Halehaven, Hinner Hale, and Gage Elberta, use 30 parts per million (3 times the concentration for preharvest sprays).

3. For Redhaven use 40 parts per million.

4. For Golden Jubilee and Georgia Belle use 20 parts per million.

The caustic *dinitro* materials will thin peaches if applied when about 90 percent of the flowers are open. Timing is very important, but correct timing is difficult if weather conditions delay blooming. Dn-Dry thinned Elberta satisfactorily in 1956 when applied at a concentration of 1½ pounds per 100 gallons of water. In earlier tests Elgetol gave good results with Elberta at 1½ to 2 pints in 100 gallons.

General suggestions on chemical thinning

Weather conditions must be right. Temperature and humidity are very important in chemical thinning. Drying conditions must be good. If the relative humidity is so high that the spray dries slowly, thinning will be too great.

Experience in Illinois indicates that when NAA is used, the mean temperature on the day of application should be 60° F. or higher. Similar temperature for a day or two after spraying may also be necessary for good results.

Method of application. Application should be thorough. Spray the trees from both sides, using enough gallonage that the trees will drip. However, do not overspray the lower third of the tree, particularly the inside, which is less vigorous than the upper part.

Apply thinning chemicals as separate sprays. This will permit you to vary the amount of material according to tree vigor and amount of bloom. Also, insecticides and fungicides may alter the power of the thinning spray.

Thining materials may be applied in dust form. Wet dusts have greater thinning power than dry dusts, probably because more of the material adheres.

FOUR GENERAL ORCHARD PESTS

Grasshopper Control

For several years grasshoppers have been troublesome in many orchards. Damage may occur on the foliage of young, nonbearing trees or on the fruit and foliage of bearing trees. To control this pest, use one of the following materials:

	Amount per acre for —		
	Young hoppers	*Adult hoppers*	*Residual toxicity*
Chlordane	½ lb. actual	1 lb. actual	Excellent
Toxaphene	1 ½ lb. actual	2 lb. actual	Excellent
Aldrin	2 oz. actual	2 oz. actual	Excellent
Dieldrin	1 oz. actual	2 oz. actual	Excellent

Cicada Control

A spray containing 2 pounds of sevin in 100 gallons of water is suggested for application in and around blocks where cicada adults are numerous. This is a contact spray, with a high residual toxicity. Where cicadas are coming in at a rapid rate sevin should be applied

at 5-day intervals during their attack. Where they are not too numerous an 8-day schedule is satisfactory.

Sevin should not be applied to bearing apple trees until 14 days after petal-fall, or it will thin off the fruit. Thus, should cicada control be necessary before this time use ¼ to ⅓ pint of 30-percent TEPP in 100 gallons of water. This is a contact spray with no residual effect and gives best control if applied at night when the cicadas are at rest. As soon as 14 days have elapsed after petal-fall, change over to sevin.

Bark Beetles

Bark beetles usually attack only weakened trees or branches, although they are occasionally found on healthy trees. Usually they can be controlled if the vigor of the tree is increased by means of fertilizers, proper drainage, or scale control. The treatments described for the lesser peach tree borer (page 27) are also moderately effective in controlling these beetles.

Rodent Control

For latest information on rodent control in the orchard, write to the Wild Life Research Section, Illinois State Natural History Survey, Natural Resources Building, Urbana.

BE CAREFUL WITH PESTICIDES

Most Pesticides Are Poisonous

Some pesticides are hazardous to the operator who prepares and applies them; some are toxic to plants; some may leave toxic residues that are dangerous to consumers; and a few are hazardous because they tend to contaminate the flavor of foods or feeds. So be sure to observe strict precautions when using pesticides.

To know what the hazards of a specific pesticide are, *read the labels.* All pesticides sold in interstate commerce have been registered and labeled under federal regulations. The labels contain the most accurate information currently available on the specific uses and the hazards of these materials.

Tolerances Established

Much of the research that federal agencies are now doing on pesticides is with the purpose of establishing tolerances for residues in or on food. Tolerances have been proposed for a number of pesticides (pages 10 and 11). As new data become available, some of these

RESIDUES OF DIFFERENT PESTICIDES TOLERATED ON FRUIT

The following list of residue tolerances applies only to the deciduous fruits grown in Illinois. If changes are made in this list, a supplement will be issued before the growing season starts. **Growers are urged to follow the manufacturer's label at all times.**

Materials and tolerance in p.p.m.	Number of days between last application and harvest, and other limitations					
	Apples	Apricots	Cherries	Peaches	Pears	Plums
Acti-dione, N.R.	..	..	4	..	..	..
Aldrin, 0.25 on apples, pears, apricots; 0.1 on plums, cherries, peaches	30	21	21	21	30	21
Aramite, 0	Do not apply after fruit begins to form					
BHC, 5.0	Do not apply after fruit begins to form					
Bordeaux mixture, exempt	No time limitations					
Captan, 100	No time limitations					
Chlordane, 0.3	30	30	..	30	30	..
Chlorobenzilate, 5.0 on apples, pears; N.R.[a] on cherries	14	..	[b]	..	7	..
Cuprous oxide, exempt	..	..	30	..	..	..
DDT, 7.0	30	42	30	30	30	30
Demeton, 0.75	21	..	21	21	21	21
Diazinon, 0.75	10	10	20	20	10	10
Dichlone, N.R. on apricots and cherries; 3.0 on other fruits	3	[c]	3	14	3	3
Dieldrin, 0.25 on apples, pears, cherries; 0.1 on apricots, peaches, plums	35	45	30	45	35	45
DN 111, 1.0	15	15	15	30	15	15
DNOC, N.R.	Dormant application only					
Dodine, N.R.	[d]	..	..	..	..	..
Endrin, 0	[e]	..	..	..	..	..
EPN, 3.0	21	21	21	21	21	21
Ethion, N.R.	Dormant application only					
Ferbam, 7.0	7	[c]	7	[c]	7	35
Genite 923, N.R.	Do not apply after fruit begins to form					
Glyodin, 5.0	No time limitations					
Guthion, 2.0[e]	15	21	15	21	15	15
Heptachlor, 0.1	15	..	30	30	..	..
Karathane, N.R.	21	45	..	45	21	..

(For footnotes see page 11.)

RESIDUES TOLERATED ON FRUIT — Concluded

Materials and tolerance in p.p.m.	Number of days between last application and harvest, and other limitations					
	Apples	Apricots	Cherries	Peaches	Pears	Plums
Kelthane, 5.0	7	14	7	14	7	7
Lead arsenate, 7.0	30	30	30	30	30	30
Lindane, 10.0	Do not apply after fruit begins to form					
Malathion, 8.0	3	7	3	7	3	3
Maneb, 7.0 on apples; 10.0 on peaches, apricots	0	14	..	14[f]	..	..
Mercury, organic, 0	[e]	..	..	[g]	..	..
Methoxychlor, 14.0	7	7	7	14	7	7
Naphthaleneacetic acid, 1.0	7	..	..	..	..	..
Niacide M, 7.0	No time limitations					
Nicotine sulfate, 2.0	3	3	3	3	..	3
Ovex, 3.0	30	..	[b]	30	30	30
Parathion, 1.0	14	14	14	14	14	14
Phaltan, N.R.	Do not apply after fruit begins to form					
Phosdrin, 0.5 on apples, pears; 1.0 on peaches, plums	1	..	..	1	1	1
Sevin, 10.0	1	..	..	1	1	..
Streptomycin, N.R.	[e]	..	..	..	[e]	..
Sulfur, exempt	No time limitations					
Sulphenone, 8.0	7	..	..	14	7	..
Summer oils, exempt	No time limitations					
TDE, 7.0	30	30	30	30	30	30
Tedion, 5.0	Do not use more than 1 pound after first cover					
TEPP, N.R.	3	3	3	3	3	3
Thiram, 7.0 on apples, peaches	No time limitations					
Toxaphene, 7.0	40	..	..	40	40	..
Trithion, 0.8	30	30	30	30	30	30
Zineb, 7.0	7	[e]	7	[e]	7	45
Ziram, 7.0	0	[e]	7	[f]	0	..

[a] N.R. = no residue allowed because a tolerance has not yet been established.
[b] Use only after harvest.
[c] Do not apply after fruit begins to form.
[d] Do not apply after first cover.
[e] Do not apply more than eight times a season.
[f] If applied within 14 days of harvest, remove residue by brushing. Do not apply within 2 days of harvest.
[g] Dormant application only.

tolerances may be changed and tolerances on other pesticides will probably be proposed.

The spray schedules in this circular have been planned so that residues at harvest will not exceed these tolerances. Also, as already mentioned, the labels contain accurate and important information. It is especially important to follow the instructions concerning lapse of time between final spray application and harvest.

Remember — do not use more pesticide than needed and do not apply when dangerous residues may result.

Careless Use of Pesticides Invites Death

The organic phosphates — including such materials as parathion, demeton, and TEPP — are especially dangerous chemicals (page 39). Careless use of parathion alone has caused one known death and several near deaths in Illinois. It is not any safer to use the organic phosphates alternately than it is to use one of them continuously. So, although they are highly effective insecticides they should not be used where a safer material will give reasonably satisfactory control. Where situations demand the application of organic phosphates and where you can enforce proper precautions, their use may be justified.

It is absolutely essential that these precautions be followed:

1. Be extremely cautious when using with oil, as oil causes the skin to absorb more organic phosphate.

2. Do not spray from the inside of the tree.

3. Secure a special respirator that has been officially approved for use with the organic phosphates. Make sure you have the right mask. An orchard canister is not suitable for the greenhouse. The following respirators are suggested:

Respirator No. 5561, cartridge No. R-561.
American Optical Company, Southbridge, Massachusetts.

Respirator No. CR-72138, cartridge No. CR-49293, filter No. 73488.
Mine Safety Appliances Company, Pittsburgh, Pennsylvania.

Agritox Respirator, cartridge No. 11A, filter No. R-490.
Willson Products, Inc., Reading, Pennsylvania.

4. Use the mask to protect lips, nose, and mouth from accumulating residue, especially while you are emptying sacks of organic phosphate into the spray tanks. Wear the mask all the time while spraying in the orchard.

5. Never spray when you are alone. You may become suddenly ill and need help to get to the doctor.

6. **Stand out of the drift** when putting the powder into the tank or emptying the sacks of dust into the hopper for dusting — even when you are wearing the proper mask.

7. **Do not wash the material through the screen** into the tank. Sift it in quickly with the screen removed.

8. **Do not breathe dust or powder.**

9. **Dust with the wind** and be careful of the turns at the ends of the rows. A duster or sprayer operated by one man with controls at the tractor is safer than the more common, manually operated, two-man outfit.

10. **Wash hands thoroughly** after each contact with the material and before touching the lips, eyes, etc., and before eating any food.

11. **Do not smoke** while spraying or dusting.

12. **Change clothes and bathe** at least daily. Accidentally soaked clothes should be replaced at once.

Atropine is the emergency antidote for organic-phosphate poisoning. Keep on hand a supply of atropine tablets (1/120 grain or 0.5 mg.). You will need a doctor's prescription to get them. Never take atropine or similar drugs until AFTER warning symptoms appear. Symptoms of organic-phosphate poisoning include headache, blurred vision, weakness, nausea, cramps, diarrhea, and discomfort in the chest. If you feel any symptoms while spraying with an organic phosphate, quit spraying, take two atropine tablets at once, and go to a doctor.

If you handle organic phosphate insecticides regularly, you should go to your doctor periodically for blood cholinesterase determinations.

Do not use organic phosphates unless you can rigidly follow all precautions.

Rating of Materials

The list on page 14 indicates how various insecticides and acaricides (mite killers) compare in their toxicity to man. The ranking, however, is only approximate, for the information has been derived from many different sources and no standard comparative method has been applied to all the materials. Thus the list should serve only as a relative guide.

The materials are ranked in two ways — toxicity if they are ingested through the mouth and toxicity if they touch the skin. Dieldrin, for example, rates below guthion in the oral ingestion column, but is higher in the skin contact column.

In general, the oral ingestion rating is probably the more important. It is not difficult to protect the skin, but it is difficult to keep the mouth

covered at all times. When the mouth is exposed there is also the danger of inhalation. Exercise the utmost care when using these chemicals — you are not allowed even one little mistake.

COMMONLY USED INSECTICIDES AND ACARICIDES

Ranked in Order of Decreasing Toxicity to Warm-Blooded Animals Including Man

Oral toxicity (by ingestion)		Dermal toxicity (on the skin)
TEPP	MOST TOXIC	TEPP
Parathion		Demeton
Demeton		Phosdrin
Phosdrin		Parathion
EPN		EPN
Endrin		Endrin
Guthion		
		Dieldrin
Trithion		Diazinon
DN 289		Guthion
Dieldrin		
Ethion		BHC
Lead arsenate		Ethion
BHC		Trithion
Diazinon	LESS TOXIC	
DDT		DDT
		Sevin
Malathion		TDE
Sevin		Malathion
Kelthane		
		Methoxychlor
Genite		
Ovex		Tedion
Chlorbenside		Aramite
Chlorobenzilate		Kelthane
TDE		Genite
		Lead arsenate
Methoxychlor		Ovex
Aramite	LEAST TOXIC	Chlorobenside
		Chlorobenzilate
Tedion		

INSECT AND MITE CONTROL BY CHEMICAL ROTATION

A major problem in the control of mites and insects on fruit is that they develop either resistance or tolerance to chemicals. So far this problem has been met primarily by substituting new and more effective materials. We have no assurance, however, that the flow of new materials will continue indefinitely and that we will always have effective new chemicals when they are needed. Moreover, getting a new material into proper use is time-consuming and expensive.

We now have enough chemicals with different types of killing action that we can consider a program of rotational applications. If as much time as possible is allowed between periods of using any one type of chemical, the mites and insects will be slower in building up resistance. It would be wise, therefore, to plan a basic spray program for three to four years in advance instead of just one year ahead.

Acaricides (mite killers) may be divided into several groups: Dinitros, petroleum oils, Kelthane and Chlorobenzilate, phosphorus-based materials, and sulfur-based materials. Following is an example of a possible schedule for the control of mites:

Year	Early season	Late season[a]
1st	Dormant oil	Sulfur-based material
2nd	Dinitro	Phosphorus-based material
3rd	Sulfur-based material	Kelthane or Chlorobenzilate

[a] Late-season use should definitely include two applications.

This schedule is only an example and can be varied in many ways. Any schedule planned in advance will have to be modified in accordance with variations in weather and insect populations.

Phosphorus-based insecticides could be used with the dormant oil in the above schedule and should be incorporated into the mite-control plan if possible.

In all, orchard insecticides may be divided into four groups: the phosphorus-based compounds, arsenicals, chlorinated hydrocarbons, and certain carbamates. Rotational planning for insect control is more difficult than for mite control for several reasons: (1) Fewer chemical groups of insecticides are available; (2) more variations exist in the killing actions required against different insect pests; (3) there are more variations in the times when different pests need to be controlled.

If rotational spray schedules are used, it is especially important to know what your specific control problems are and to keep constantly informed on population levels of various pests in your orchard. You will thus be more nearly able to get the control you want when you are using the less effective materials.

It is especially important to look for the areas where mites usually appear first, the spots where the most fruit damage occurs, and any other clues that will help you to detect problems. When help is hired on a continuing basis, it may be practical to train workers to recognize symptoms of pest damage. Even simple records of spray schedules,

date and location of pest appearances, and similar information may be invaluable resources in future planning.

Following is an example of one possible rotational schedule, splitting the season at the end of the first brood codling moth:

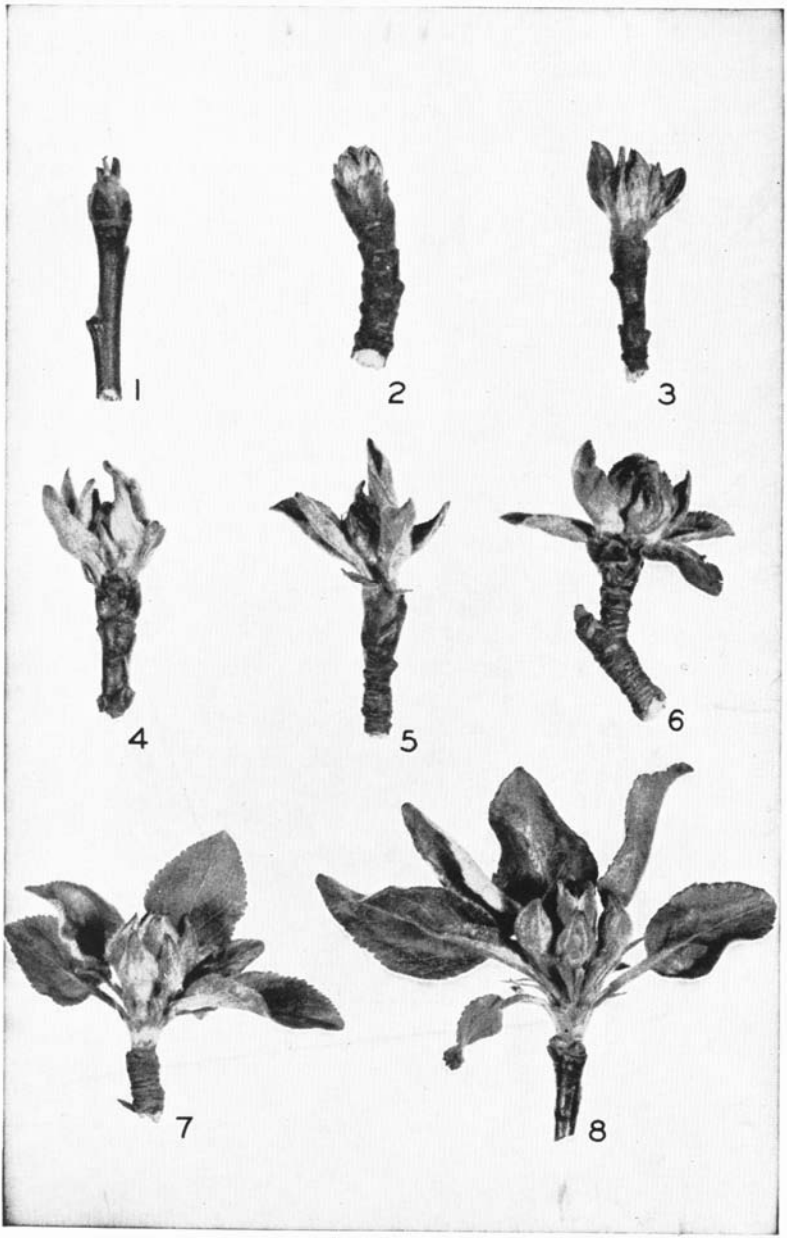
Year	Dormant	Prebloom	Early season	Late season
1....	None	Tedion, Guthion	Guthion	Methoxychlor, parathion, Kelthane
2....	Oil, Ethion	Endrin	Endrin, lead arsenate, ovex, sevin	Diazinon, TDE, Trithion
3....	None	Guthion	Guthion	Sevin, Chlorobenzilate
4....	DN 289 or Elgetol 318	Genite, TDE	TDE, dieldrin, lead arsenate, DDT, malathion	Guthion
5....	None	Chlorbenside, BHC, endrin	Lead arsenate, endrin, sevin	DDT, EPN

Dosages Needed for Control

To "control" an insect, mite, or disease infestation means to curb, restrain, or check these pests. In chemical control we apply a measured quantity of chemical to kill or inhibit all or part of a population of insects, mites, bacteria, or fungus spores. The effectiveness of this "measured quantity" will depend partly on the chemical's natural toxicity to the organism it is supposed to control. Effectiveness also varies with the physical characteristics that will enable a material to reach the site of an infestation in a large enough amount to be active.

These two factors, plus a number of others, will determine the specific dosage to be used in a practical situation. These other factors include the degree of infestation, the number of applications planned, weather conditions, thoroughness of coverage, and the toxicity of the chemical to the host plant.

Since some of these factors will vary from day to day, the dosage of a chemical will also need to be varied to obtain the best control. Most recommendations give the optimum dosage needed for an average infestation. If an infestation is less than average, the concentration of a chemical might be reduced. With a higher than average infestation, the recommended concentration should be used and extra care taken to secure complete coverage. It would not be wise to exceed the optimum dosage on a dilute basis, for such reasons as the residue problem, plant tolerance, and cost.



Time apple sprays with development of fruit buds. Apply the strictly dormant sprays before Stage 1. Apply delayed dormant sprays during Stage 2. Apply prepink spray between Stages 3 and 6. Start the pink spray at Stage 7 (not later than 8), and complete by the time the first flowers open. (Fig. 2)

PEST CONTROL ON APPLES

Dormant Spray: All Apples

Purpose	Time to apply	Materials in 100 gallons of water
		Insecticides and acaricides
For all scale insects, aphids, European red mite	Before buds are open. Early spring is safest and most effective time	*1st year:* None *2nd year:* 2% ethion-oil mixture, 2 gal., *or* Trithion 4-EK, 1 pt., plus 1 gal. oil *3rd year:* DN 289 (Elgetol 318), 2-3 qt. *4th year:* None *5th year:* Dormant oil, 3 gal., DNC, 1 lb. actual
		Fungicide
For black rot, fireblight, blotch	Either late fall or spring while buds are dormant	Copper sulfate, 4 lb.

The above insecticide recommendations are for the purpose of destroying all the various scale insects, mites, and aphids that may be in your orchard. The later the spray can be applied in relation to bud development, the more effective it will be. It is important, however, that the buds be strictly dormant or they may be injured, especially if dinitros are applied.

Copper sulfate should be applied separately and not combined with the insecticides. Applied alone during the strictly dormant period, it will help to control many diseases. If possible, it should be applied in the fall so that it will not interfere with the regular spring dormant spray. It may be applied in the spring, however, as far as effectiveness is concerned.

Prepink Spray: All Apples

Purpose	Time to apply	Materials in 100 gallons of water
For apple scab and powdery mildew	Before flower buds show pink (Fig. 2, Stages 3 through 6)	Dodine 65W, ¼ lb., plus microfine sulfur, 4 lb., *or* organic mercury ½ strength (see labels for dosage) plus microfine sulfur, 4 lb., *or* lime sulfur (liquid, 2 gal.; dry, 8 lb.)

The above recommendations are for both powdery mildew and apple scab. If you need to control only apple scab, you can omit the sulfur and increase the other fungicide to full strength or double the

above suggestions. It is important to apply this spray as soon as the buds break open to expose the new leaves.

When sulfur is omitted from the early sprays, powdery mildew may cause trouble on Illinois apples. Jonathan and Rome Beauty are the most susceptible of the varieties grown for commercial production. Sulfur is recommended to control this disease. Microfine sulfur includes the many commercial brands of wettable sulfurs, such as pastes or dry forms having particles with an average diameter of 2 to 10 microns. Karathane will also control powdery mildew and may be substituted for sulfur. Applied at the rate of ¾ pound in 100 gallons of water, it is as effective as sulfur for mildew control. Unfortunately, Karathane is not too effective for scab control, thus when it is used the other fungicide will need to be increased to full strength.

More than one prepink spray may be necessary when cold and rainy weather prolongs tree development. Sulfur dusts may be used to supplement the sprays. Dusts containing dichlone and sulfur are also effective.

If a specific acaricide has been used at half strength in the prepink spray, it should be used again in the pink at half to full strength, depending on the number of European red mite eggs present.

THOROUGH SPRAYING IS ESSENTIAL FOR ALL FRUITS

Use adequate pressure. Do not rely on measurements of pressure gages after two or more seasons of service — have the gages checked.

Select disks with correct openings and replace worn disks. Be sure the disks will carry the maximum load. A 35-gallon pump should discharge at least 30 gallons a minute during full operation.

Spray tops of trees with special care. Equip the spray rig with a tower. Apply top-off sprays when recommended.

Examine fruit and leaves frequently. Look for evidence of disease and insect injury. See whether spray coverage is complete, especially in tops of trees.

Apply enough spray. And remember that one good spray is worth more than two poor ones.

Pink or Cluster-bud Spray: All Apples

Purpose	Time to apply	Materials in 100 gallons of water
		Insecticides and acaricides
For curculio, red-banded leaf roller, aphids, mites	When most of the buds in the cluster have separated but before the blossoms have opened (see Fig. 2, stages 7 and 8)	*1st year:* Guthion 25W, 1¼ lb. *2nd year:* Endrin, ¼ lb. actual *3rd year:* TDE 50W, 2 lb., and guthion 25W, 1¼ lb. *4th year:* Tedion 25W, 1 lb., and guthion 25W, 1¼ lb. *5th year:* Endrin, ¼ lb. actual, Chlorbenside 40W, 1 lb., and BHC 10W, 2 lb.
		Fungicides
For apple scab, powdery mildew, cedar rust	Same as above	Sulfur, 4 lb.,[a] and zineb 65W, ½ lb.[b] *plus either* dodine 65W, ¼ lb. *or* captan 50W, 1 lb.
For apple scab only	Same as above	Dodine 65W, ½ lb., *or* dodine 65W, ¼ lb., and captan 50W, ½ lb. *or* organic mercury, half-strength, and glyodin, 1 pt. *or* captan 50W, 2 lb. *or* captan 50W, 1 lb., and zineb 65W, 1 lb.[b]

FOR THE COMPLETE SPRAY COMBINE YOUR CHOICE OF FUNGICIDES WITH THE INSECTICIDES AND ACARICIDES IN ONE APPLICATION

[a] Sulfur is for powdery mildew control. If this disease is not a problem, sulfur may be omitted and zineb increased to 1 lb.
[b] Niacide M may be substituted for zineb at the same concentration.

During this time of year damp weather may be conducive to serious scab infections. Sulfur dusts or dusts containing dichlone are good to use between the regular sprays to supplement the fungicide program. Glyodin gives good protective action, has good wetting and sticking qualities, and is very economical. It can therefore be used to advantage with other sprays if scab control has been obtained without allowing primary infection.

The insecticides have been set up for a five-year rotation. Which material you start with should depend on what you used the previous year. For example, if you used endrin last year, you would want to start your rotation with TDE and Genite.

Tedion need be used in the fourth-year spray only when European red mite populations are very high or when mites are the primary problem. BHC is suggested in the fifth year in case a DN or a phosphate has not been used and aphid control is necessary. Endrin may not be needed if carry-over of curculio and red-banded leaf roller is light. The unspotted tentiform leaf miner may be controlled at this time with phosphates.

Bloom Spray: All Apples

Purpose	Time to apply	Fungicides in 100 gallons of water
For apple scab, cedar rust, powdery mildew, fireblight	When about 10 percent of the blossoms have opened	Sulfur, 2 lb., zineb 65W,[a] 1 lb., and streptomycin, 50 p.p.m., *plus either* dodine 65W, ¼ lb., *or* captan 50W, 1 lb.

[a]Niacide M, 1 lb., may be substituted for the zineb.

Omit streptomycin on varieties not susceptible to fireblight. If only fireblight control is desired, then use only streptomycin. If a streptomycin schedule is to be used for fireblight control, it should be applied at 7-day intervals through the calyx or petal-fall spray.

Another fireblight material is a combination of copper sulfate, ½ lb., and hydrated lime, 1 lb. This is a Bordeaux mixture spray. It is effective against all the other diseases as well as fireblight. Use it at 4-day intervals through the bloom period. Do not combine it with any of the above chemicals.

In most seasons, cedar galls start discharging spores at the same time the apple trees are beginning to bloom. If problem blocks are not sprayed at this time, they will usually give trouble later, since it is difficult to stop infection once it gets started.

BORER CONTROL

The *roundheaded apple tree borer* usually burrows in the base of the trunk, anywhere from 2 inches below the ground to a foot or more above. Almost perfect control has been achieved with lead arsenate, 3 pounds, and 50-percent DDT, 2 pounds, in 100 gallons of water. Starting 3 weeks after petal-fall, make four applications 2 weeks apart. For further information write to the Illinois State Natural History Survey, Urbana.

The *flatheaded apple tree borer* works higher on the trunk and sometimes infests the branches. It nearly always locates on the sunny side of a tree, but may be found on all sides. Weakened trees are especially susceptible. Shading the trunk gives some control. Either wrap it or put two boards, nailed together to form a trough, near the south and west sides. Best protection is to keep trees vigorous.

Time to apply calyx spray for scab and codling moth (above). Petals have just fallen but calyx lobes are still open. (Fig. 3)

Too late for calyx spray (right). Calyx lobes have closed. (Fig. 4)

A SIMPLE WAY TO FIGURE AMOUNT OF NON-CONCENTRATE SPRAY FOR APPLE TREES

For dormant and *prepink* sprays, divide age of tree by 4 to find gallons needed per tree. For *pink* spray, divide by 3; for *calyx*, divide by 2; for *succeeding* sprays, divide by 1.5. *Example:* a 10-year-old tree should be given the following amounts:

Dormant and prepink stages	2.5 gallons
Pink stage	3.3 gallons
Calyx stage	5.0 gallons
Each succeeding spray	6.7 gallons

Calyx and First Cover Sprays: All Apples

Purpose	Time to apply	Materials in 100 gallons of water
		Insecticides and acaricides
For codling moth, curculio, red-banded leaf roller, aphids, mites	**Calyx spray:** when ¾ of petals have fallen and before calyx cups have closed (Fig. 3). **First cover:** 7 to 10 days later	*1st year:* Guthion 25W, 1¼ lb. *2nd year:* Lead arsenate, 3 lb., and endrin, ¼ lb. actual *3rd year:* Lead arsenate, 3 lb., dieldrin 50W, ½ lb., and TDE 50W, 2 lb. *4th year:* Guthion 25W, 1¼ lb. *5th year:* Lead arsenate, 3 lb., and endrin, ¼ lb. actual
		Fungicides
For apple scab, cedar and quince rust, blotch	Same as above	Sulfur, 2 lb.; zineb 65W,[a] 1 lb., *plus either* dodine 65W, ¼ lb., *or* captan 50W, 1 lb.

[a] Niacide M may be substituted for zineb at the same concentration.

On blight-susceptible varieties, add streptomycin, 50 p.p.m., to whatever combination is selected for the calyx spray. Because of the residue hazard, streptomycin cannot be used later than the calyx spray on bearing trees.

When time permits, special top-off sprays are suggested after the calyx and first cover sprays. Use the same materials and apply to the top third of the tree within 2 or 3 days after the regular spray. If a top-off spray follows the calyx spray, the first cover should be applied 7 days after the top-off.

A ½-1-100 Bordeaux mixture may be applied as a special spray at 3- to 4-day intervals during this period. Such a spray, when applied in this manner until July 1, has given excellent control of fireblight. Although it is expensive, troublesome, and likely to cause russet, it might save the trees in problem blocks. Bordeaux mixture cannot be combined with organic insecticides and fungicides because it is incompatible with them.

Second, Third, Fourth, and Fifth Cover Sprays: All Apples

Purpose	Time to apply	Materials in 100 gallons of water
		Insecticides and acaricides
For curculio, codling moth, leafhopper, red-banded leaf roller, aphids, tentiform leaf miner, mites	At 7- to 10-day intervals after 1st cover sprays, or as needed. Sometimes intervals can be 14 days	*1st year:* Guthion 25W, 1¼ lb. *2nd year:* Sevin 50W, 2 lb., and ovex, ½ lb. *3rd year:* DDT 50W, 2 lb., and malathion 25W, 2 lb. *4th year:* Guthion 25W, 1¼ lb. *5th year:* Sevin 50W, 1 to 2 lb., and demeton 26E, ¾ pt.
		Fungicides
For scab, blotch, sooty blotch, flyspeck, bitter rot, black rot, *Botryosphaeria*	Same as above	Captan 50W, 1 lb., *plus either* zineb 65W,[a] 1 lb., *or* zineb 65W,[a] ½ lb., and glyodin, 1 pt.

[a] Niacide M may be substituted for zineb at the same concentrations.

The second cover is one of the most important sprays for codling moth control. At this time of year the first eggs hatch and the young larvae attack the fruit. It is important to cover the apples thoroughly before egg hatch occurs. Start watching for scale crawlers also about this time.

After the fourth and fifth cover sprays, climb the trees and check for codling moth damage in the tops. Also check for leaf rollers on water sprouts and for mites inside the trees. Four-spotted mites may show up first by yellowing along the midribs, especially in the top center of the trees.

The acaricides ovex and demeton, suggested for the second and fifth years, respectively, are not necessary unless the mite population is high. If using ovex, make two or three successive applications.

Malathion, suggested for the third year, has been successfully used as the only insecticide throughout the entire season that it was first used in the block.

It is suggested that these cover sprays be continued until the end of the first brood codling moth.

Sixth and Remaining Covers: Fall and Winter Apples

Purpose	Time to apply	Materials in 100 gallons of water
		Insecticides and acaricides
For 2nd and 3rd brood codling moth, 3rd and 4th brood red-banded leaf roller, apple maggot, mites	As needed for control of late broods of insects and mites and of summer disease	*1st year:* Methoxychlor 50W, 2 lb., parathion 15W, 1 lb., and Kelthane 18.5W, 2 lb., or 18.5 EC, 2 pt. *2nd year:* Guthion 25W, 1¼ lb. *3rd year:* Sevin 50W, 1 to 2 lb., and Chlorobenzilate 25W, 1¼ lb. *4th year:* Methoxychlor 50W, 2 lb., and EPN 25W, 1¼ lb.
		Fungicides
For bitter rot, *Botryosphaeria,* and other diseases	Same as above	Captan 50W, 1 lb., and glyodin, 1 pt.

It is advisable that the spray program be changed at the beginning of the second brood codling moth. The above suggestions are for a possible rotational program. For more exact timing of the sprays, see the spray service report.

Several additional materials may be useful. Trithion 25W, 1 lb., may be used to control mites during cover sprays as well as in the delayed dormant. It will give some insect control, but when used alone it is not effective enough for such insects as codling moth.

Phosdrin is an organic phosphate that appears to control red-banded leaf roller more effectively than other materials. Should the third brood develop, it might be wise to consider the use of phosdrin 15E, 1 pt. Such an application may also be useful when unexpectedly large populations of any pest appear or when control is needed just before harvest.

Even when adjustments are made in the use of specific acaricides — that is, when they are omitted from a certain spray or when they are used in addition to planned sprays — they should still be used in rotation with other acaricides.

PEACHES AND APRICOTS

Rotational Control Suggested

The following spray schedules do not contain specific suggestions for rotating insecticides. It is, however, suggested that a rotational pattern of control be considered for each block. Fewer insecticides are needed on peaches than on apples; thus it's easier to rotate the main insecticides. Good control has been maintained with all these chemicals: Dieldrin, DDT, parathion, guthion, sevin, and malathion. It is therefore possible to alternate between these materials from year to year.

Dormant Spray: Peaches and Apricots

Purpose	Time to apply	Materials in 100 gallons of water
For San Jose and Forbes scale, European red mite, leaf curl	In the spring before buds start to swell. Do not apply after growth starts	Dormant oil, 3 gal. actual Copper sulfate, 4 lb. Hydrated lime, 3 lb.
For scale insects and mites only	Same as above	Dormant oil, 3 gal. actual
For leaf curl only	Same as above	Any fungicide, full strength

The dormant spray is essential because it reduces the number of mites and scale insects. If populations of these pests are low to start with, summer control is much easier. Furthermore, both scale insects and mites are becoming resistant to organic phosphate insecticides in some orchards. When this resistance develops, the only recourse is to kill as many as possible in the dormant period.

After the 1959 season, every peach grower should be aware of the potential danger of peach leaf curl. It can only be controlled *before* the growing season starts. After the spores begin to germinate, the germ tubes enter the leaves and develop internally; thus they are protected from eradicant fungicides.

Prebloom, Early Bloom, and Bloom Sprays: Peaches and Apricots

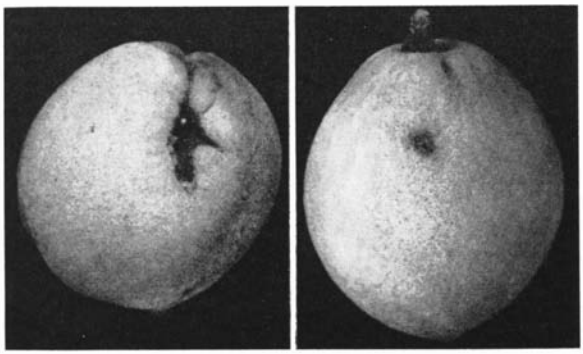
Application and purpose	Time to apply	Materials in 100 gallons of water
Prebloom, for curculio and catfacing insects	Just before blossoms begin to open	50% dieldrin, ½ lb., *or* 15% parathion, 2 lb. (*If preferred, a commercial dieldrin, DDT, or parathion dust may be used instead*)
Early bloom, for brown rot blossom blight, curculio, catfacing insects	When 5% of blossoms are open	Microfine sulfur, 3 lb., and 50% dichlone, ¼ lb., *plus either* 50% dieldrin, ½ lb., *or* 15% parathion, 2 lb., *or* 25% guthion, 1¼ lb. (*Or make 2nd dust application, preferably one containing dichlone*)
Bloom, for brown rot blossom blight	As near to full-bloom stage as possible	Microfine sulfur, 3 lb., and 50% dichlone, ¼ lb. (*Or use a non-insecticide sulfur-dichlone dust*)

The **prebloom** spray is to be used only where curculio and catfacing insects have caused special problems. At this time of year, these insects are especially likely to be in the orchard border. So treat the outside rows especially well.

Be sure to read the labels on the packages of fungicides and insecticides. Observe special caution when using organic phosphates. Dusts of parathion and guthion are particularly dangerous.

The **early bloom** spray is particularly important for controlling brown rot blossom blight. Only the very young blossoms are susceptible.

To avoid possible damage to bees, the **bloom** spray should not include an insecticide.



Cat-faced peach (near right) and peach with curculio damage (far right). (Fig. 5)

Petal-Fall, Shuck-Split, First and Second Covers: Peaches and Apricots

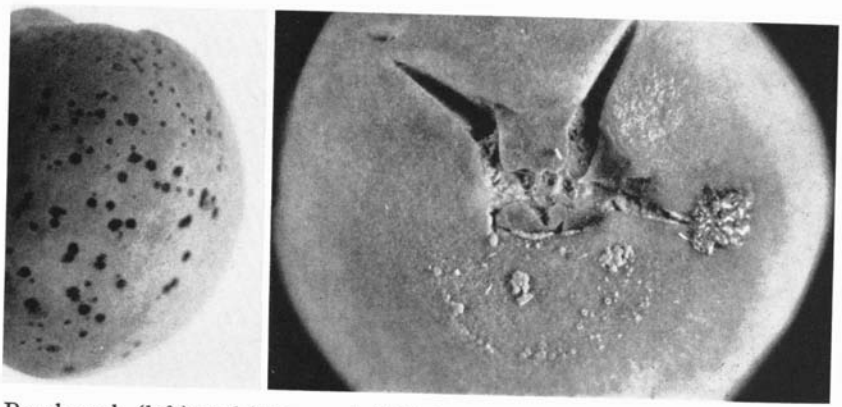
Application and purpose	Time to apply	Materials in 100 gallons of water
Petal-fall, for brown rot, curculio, catfacing insects	When at least ¾ of petals have fallen	Microfine sulfur, 6 lb., *plus either* 50% dieldrin, ½ lb., *or* 50% sevin, 2 lb., *or* 15% parathion, 2 lb., *or* 25% guthion, 1¼ lb. (*If preferred, either dieldrin, sevin, or parathion dust may be used*)
Shuck-split, for curculio, brown rot, catfacing insects	When ¼ of the shucks are splitting	Same as for petal-fall (*If preferred, dieldrin or parathion dust may be used*)
1st and 2nd covers, for same pests as above	At 10-day intervals following shuck-split	Same as for petal-fall (*If preferred, dieldrin or parathion dust may be used*)

The **petal-fall** application is important in cool seasons when tree development is slow. The **shuck-split** and **first and second covers** come when young fruits are first exposed and thus need protection.

Parathion dusts are safest when applied with a liquid duster. Do not dust when the wind will carry the material into nearby residences. Follow the necessary precautions when using organic phosphates.

Mites may start building up at the time of the shuck-split and first and second covers. If so, include one of the following materials in the regular sprays: 18.5-percent Kelthane, 2 pounds of the wettable powder or 2 pints of the emulsifiable concentrate; Chlorobenzilate 25W, 1½ pound; or ovex 50W, ½ pound.

Apply thinning sprays (page 6) 2 weeks after shuck-off.



Peach scab (left) and brown rot (right). (Fig. 6)

Third and Following Covers: Peaches and Apricots

Application and purpose	Time to apply	Materials in 100 gallons of water
3rd and 4th covers, for curculio, stink bug, oriental fruit moth, brown rot, scab	At 10-day intervals after the 2nd cover	50% captan, 2 lb., *or* microfine sulfur, 6 lb., *plus either* 50% sevin, 2 lb., *or* 15% parathion, 2 lb., *or* 25% guthion, 1¼ lb., *or* 25% malathion, 3 lb., *or* 50% DDT, 2 lb., *or* 50% dieldrin, ½ lb.[a] (*Or use sevin or parathion dust*[b])
5th cover, for curculio, oriental fruit moth, brown rot	About 1 month before harvest	50% captan, 2 lb., *or* microfine sulfur, 6 lb., *plus either* 50% sevin, 2 lb., *or* 25% parathion, 1¼ lb., *or* 25% guthion, 2 lb., *or* 25% malathion, 3 lb. (*Or use parathion dust*)
6th, 7th, and 8th covers, for brown rot	21, 14, and 7 days before harvest	50% captan, 2 lb. (*Or use 7.5% captan dust*)

[a] Omit dieldrin in the fourth cover. Neither DDT nor dieldrin should be used at this time on peaches because of the residue problem.

[b] Since dust applications usually do not control pests as satisfactorily as sprays, it may be necessary to space the dust applications 7 days apart instead of 10. An extra dusting is advisable.

The **fifth cover** should be timed to protect the fruit from attack of second-brood curculio and third-brood oriental fruit moth. This is usually the last insecticide spray before harvest, although the organic phosphates may be used closer to harvest if necessary.

All these sprays are important for the control of brown rot, which is one of the most serious diseases of peach, apricot, plum, and cherry. This disease is not difficult to control when the fruits are not injured. But even the slightest injury, such as a puncture by a stink bug's beak or a tiny pin prick, is enough to allow the fungus to enter the flesh of the fruit. After a fruit is picked, the area where it has been broken off the stem is susceptible to infection. Hydrocooling is suggested, where it is available, for peaches that are to be shipped long distances.

Peach Tree Borer Control

Special attention is usually needed to control the peach tree borer and lesser peach tree borer. The peach tree borer infests the trunk of the tree near the soil level. The lesser peach tree borer infests the trunk and scaffold branches, especially near wounds or weak crotches.

Parathion and guthion are recommended for controlling both borers. DDT will control the peach tree borer but is not effective for the lesser peach tree borer. If you use parathion or guthion in your regular

schedule, you may get control by making a special effort to hit the trunk and scaffold branches with the sprays.

When the regular schedule does not give satisfactory control, the following special sprays are suggested:

Purpose	Approximate dates of application[a]	Materials in 100 gallons of water
For peach tree borer	July 5 and 25 and August 15	50% DDT, 6 lb. *or* 15% parathion, 3 lb. *or* 25% guthion, 2 lb.
For peach tree borer and lesser peach tree borer	June 10, July 5 and 25, and August 15	25% malathion, 3 lb. *or* 15% parathion, 3 lb. *or* 25% guthion, 2 lb.

[a] These dates apply to the southern third of Illinois. They would be somewhat later in the northern areas.

When applying these heavy mixtures, do not spray the fruit. If parathion or guthion is used, you may be able to control both borers with the same sprays, applying them on the dates suggested for the lesser peach tree borer.

Crystalline paradichlorobenzene (PDB) will also give reasonably good control of the peach tree borer. Apply it to the ground in a ring around the tree — just far enough away that it does not touch the bark. Then cover it with 3 to 5 spadefuls of earth. Use these amounts of PDB:

Trees 1 year old, ¼ oz. **Trees 3 to 5 years old, ¾ oz.**
Trees 2 years old, ½ oz. **Trees 6 to 10 years old, 1 oz.**
Trees older than 10 years, 1 to 2 oz.

Treatments are more effective in the fall than in the spring. Soil temperature should be 55° or over to volatilize the material. In general, the best dates for treatment are from September 25 to October 15, depending on latitude and soil temperatures.

How Many Bugs Are on Your Trees?

An easy way to determine how many tarnished plant bugs, curculios, stink bugs, and other catfacing insects are on your trees is to jar or bump them off and count them. First spread white cloth under the branches (two sheets work fine) without touching the branches. Then give the branches in the main framework a sudden jar, using a pole with a piece of rubber tire on the end. Many of the insects will fall to the sheet and will "play possum" long enough to be counted.

Make such a count on five trees, one in each of five edge rows where insects will be most numerous. Jar the same trees once or twice a week and keep a record of the count. This will help you to determine the general insect population in your orchard and to decide what sprays to use and when and how to use them.

Virus Diseases

Peach yellows, peach rosette, phony peach, and yellow-red virosis are virus diseases of peaches that are known to be present in Illinois. Peach yellows is often harbored in the plum, where the symptoms are inconspicuous. Wild plums should therefore not be left growing near peach orchards. Yellow-red virosis is primarily a disease of chokecherry, but it may spread to peaches. All chokecherries within half a mile of peach orchards should be destroyed. The common wild black cherry does not carry this virus.

If you suspect virus diseases, write the State Nursery Inspection Service, Glen Ellyn, Illinois, for an inspection. If a virus should be identified in your orchard, plan immediately to remove infected trees.

CONCENTRATE SPRAYING

A good many orchard men have saved time, labor, and materials with concentrate spraying. The theory is to use as much chemical per tree as in the standard schedules, but less water. For example, a standard recommendation for DDT might be 1 pound actual to 100 gallons. With a conventional sprayer, about 600 gallons of this mixture would be needed for an acre of orchard 25 to 30 years old. If the spray were concentrated 3 times, then 3 pounds actual of DDT would be used to 100 gallons of water, and 200 gallons would be used for an acre of orchard. Either way, 6 pounds of DDT would be applied per acre.

Tests have been conducted with as high as 10 to 12 times the normal concentration. Thus far, however, it appears that 2 to 4 times is the most practical concentration for efficient control of orchard insects and diseases.

PEARS
Spray Schedule

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant, for pear psylla and scale	Before buds begin to open. Not needed every year	Dormant oil, 3 gal.
Bloom, for fireblight	2 sprays 4 days apart starting when 10% of blooms are open	Copper sulfate, 1 lb. Hydrated lime, 3 lb. Commercial wetting agent, 2-3 oz. *(for use of streptomycin see page 37)*
Calyx, for codling moth, curculio, leaf spot, pear scab	As soon as petals have fallen	Lead arsenate, 3 lb. Hydrated lime, 3 lb. Microfine sulfur, 8 lb. *— or —* Lead arsenate, 3 lb. 75% ferbam, 1½ lb. Soybean flour, ¼ lb.
1st cover, for codling moth, curculio, leaf spot, pear scab	12 days after calyx spray	Same as for calyx
2nd cover, for codling moth, curculio, leaf spot, scab	14 days after 1st cover	Same as for calyx
3rd cover, for codling moth, curculio, leaf spot, scab	14 days after 2nd cover	Same as for calyx
Additional sprays		
— for codling moth and leaf spot.....	As needed (*see spray service report*)	Same as for calyx
— for psylla.....	When nymphs are visible on water sprouts	Copper sulfate, 2 lb. Hydrated lime, 4 lb. Summer oil, 6 qt. *— or —* 15% parathion, 2 lb. *(see pages 12 and 13 for precautions)*

PLUMS
Spray Schedule

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant, for scale insects	Before buds open	Dormant oil, 3 gal.
1st cover, for curculio, brown rot	After shucks have fallen	Lead arsenate, 3 lb. Copper sulfate, 1 lb. Hydrated lime, 2 lb. Summer oil, 1 qt.
2nd cover, for curculio, brown rot	10 days after 1st cover	Same as for 1st cover
Additional covers		
— for brown rot...	At 7-day intervals starting 3 weeks before harvest	Microfine sulfur, 8 lb., *or* 50% captan, 2 lb.
— for aphids.....	As needed	25% malathion, 2 lb.

Plums are subject to two virus diseases, rosette and yellows. The only way to control these diseases is to remove all infected trees promptly.

Black knot, a fungus disease, may be controlled by removing and burning, for two successive years, all twigs showing knots during the winter. The knots may be cut out of large limbs, thus saving the limbs. It is sometimes helpful to spray with this mixture: copper sulfate, 12 pounds; hydrated lime 12 pounds; and miscible dormant oil, 2 gallons, in 100 gallons of water. Apply to infected trees as the buds begin to swell. Follow this spray with the regular cover sprays shown in the schedule above.

For borer control, see page 29.

CHERRIES
Spray Schedule

Application and purpose	Time to apply	Materials in 100 gallons of water
Dormant, for scale insects	Before buds open	Dormant oil, 3 gal.
1st cover, for brown rot, leaf spot, curculio, slugs	After shucks have fallen	Lead arsenate, 3 lb., *or* 50% dieldrin, ½ lb., *plus either* 75% ferbam, 2 lb., *or* 65% dodine, ½ lb., *or* glyodin, 1 qt., and 75% ferbam, ½ lb.
2nd cover, for same pests as 1st cover	10 days after 1st cover	Same as for 1st cover
Additional spray, for leaf spot	After harvest	65% dodine, ½ lb., *or* glyodin, 1 qt., *or* 75% ferbam, 2 lb., *or* acti-dione, 2 p.p.m.

Brown rot, curculio, and leaf spot are the three main pests of cherry. If you can control curculio, then brown rot will not be so serious, for it can infect only the injured fruits.

Leaf spot causes loss of leaves and is sometimes so severe that the tree dies. Since it winters over in the dead leaves under the tree, raking and burning such leaves in the late fall is advisable. Either Elgetol or Kreenite, when sprayed on the ground under the tree in early spring, will further reduce winter carryover. Use either material at the rate of ½ gallon in 100 gallons of water, and apply about 500 gallons per acre.

ORCHARD FUNGICIDES AND BACTERICIDES

Acti-dione is one of the few antibiotics used against fungi. It is available in tablet form. One 380-milligram tablet to 100 gallons of water is equivalent to 1 part per million. Acti-dione is extremely toxic to fruit plants if used at rates above 2 p.p.m. Thus far, it has been approved for use only on cherries. It is especially effective against cherry leaf spot. Since this disease can be extremely destructive in the post-harvest period, a spray of 1 p.p.m. (2 tablets in 100 gallons) is recommended immediately after harvest.

Captan is available as a 50-percent wettable powder, and at full strength, 2 pounds are used to 100 gallons of water. It is also marketed as a 7.5-percent dust. Captan causes a minimum of plant injury and is especially favored for use on russet-susceptible apple varieties such as Golden Delicious. It has been effective against a large number of diseases, including apple scab, fly speck, sooty blotch, *Botryosphaeria,* bitter rot, and brown rot; but it will not control powdery mildew or the rust diseases. It is compatible with everything except alkaline and oily materials.

Dodine (Cyprex) is formulated as a 65-percent wettable powder and its recommended use at full strength is ½ pound in 100 gallons. It is to be used only for control of apple scab and cherry leaf spot. It can both eradicate these diseases and protect the orchard from them. The effectiveness of Dodine against cherry leaf spot has caused it to be termed a "wonder chemical." It is also one of the most effective fungicides available for controlling apple scab and should be used in orchards where scab has been a serious problem. Its use on apples, however, should be confined to the early sprays through the petal fall period. Although it is compatible with most orchard chemicals, it should not be used with alkaline materials such as lime.

Dichlone, when marketed as a 50-percent wettable powder, should be used at ¼ pound in 100 gallons. It is also available as a sulfur-dichlone wettable powder and as a 7.5-percent dust. It is excellent for inhibiting fungus spores and has no residual effect. At 90° F. or above, it may be toxic to plants. In Illinois it is used mainly for control of brown rot blossom blight on peaches because it is more effective than any other material for this purpose. Some growers have found a dichlone-sulfur dust effective as a supplement to the regular apple scab spray early in the spring.

Ferbam is a protective type fungicide marketed as a 76-percent wettable powder. Recommended rate of use is 2 pounds in 100 gallons. Ferbam is particularly effective against cedar apple rust, quince rust, and apple blotch. It is compatible with all orchard sprays except those containing lime and copper. It is synergistic with sulfur — that is, the two materials enhance each other's effectiveness. Ferbam is considered toxic to some russet-susceptible varieties.

Glyodin is a liquid protectant fungicide. When it is used alone the rate is 1 quart in 100 gallons. It is effective against apple scab, sooty blotch, and fly speck, and also suppresses red mites. Because of its excellent wetting and sticking properties, it is frequently combined with other fungicides and insecticides. When glyodin is used in this way, the rate is 1 pint in 100 gallons. Glyodin is compatible with all common orchard insecticides and fungicides, and has been found to increase the effectiveness of some of these materials such as captan. For all these reasons and also because of its comparatively low cost, its use is growing.

Karathane is a 50-percent active wettable powder used for powdery mildew control at the rate of ½ pound in 100 gallons. It is used primarily in the summer when sulfur is likely to be toxic to trees.

Lime sulfur is an eradicant and protectant fungicide available in both liquid and dry form. The liquid is recommended at 2 gallons in 100 gallons of water, and the dry at 8 pounds in 100 gallons. Because lime sulfur can damage trees, its use has steadily declined in the last 15 years. However, a number of growers still use it on apples in the prepink spray, since it is relatively inexpensive and is effective against apple scab.

Organic mercury compounds are available in both powder and liquid form. They should be applied according to the manufacturer's directions. Their primary use is for apple scab control. They eradicate, but do not protect. These materials should only be applied early in the season, when infections of apple scab are most serious. It is desirable to combine them at one-half strength with a protective fungicide also at half strength. To be most effective, organic mercury sprays should be applied within 72 hours after an infection period. These are the only fungicides that can be reliably used in an "after rain program." Organic mercury materials should not be applied after the fruit forms for two reasons. There is a zero mercury tolerance on fruit, and the phenyl mercuries cause fruit thinning.

Phaltan is a 50-percent wettable powder used at the rate of 2 pounds in 100 gallons. Chemically it is closely related to captan. It is,

however, slightly more toxic both to fungi and to plants than is captan. Phaltan will defoliate peaches at 1 pound in 100 gallons. Its effectiveness in controlling *Botryosphaeria* rot on apple fruits has brought it notice. It can be used in summer sprays at the rate of ½ to 1 pound in 100 gallons without causing fruit russet. Thus far, however, it has not received clearance for use on apples.

Streptomycin is available in many different powder and liquid formulations. It is the only effective treatment for the fireblight disease of apple and pear. Because a residue tolerance has not been established, its use is confined to the pre-fruit stage. At least three sprays at 50 p.p.m. are recommended, beginning when the first blossoms open and continuing at 5- to 7-day intervals until petal-fall. It may be combined with other sprays if necessary.

Sulfur, a protectant fungicide, is available as microfine wettable powder. Recommended rate, when it is used alone, is 6 to 8 pounds in 100 gallons. (Paste forms of sulfur are still available commercially, but are not generally used because they are inconvenient to handle.) Sulfur is now recommended at half strength (3 to 4 pounds in 100 gallons) in combination with half strength of an organic material. This combination is a very effective fungicide against apple scab and also gives protection against powdery mildew infection. As the weather gets warm, sulfur is omitted from the spray and if powdery mildew control is still desired, Karathane is added. Sulfur is still the mainstay in the control of peach diseases and is recommended throughout the season except in preharvest applications. It is especially important in the early cover sprays to control peach scab.

Thiram is a 50-percent wettable powder recommended at 2 pounds in 100 gallons. This protectant fungicide is effective against many diseases such as apple scab, apple blotch, cedar apple, and quince rust. It may also reduce *Botryosphaeria* infections. It is considered to give excellent finish on russet-susceptible varieties such as Golden Delicious. It is very compatible with all common fungicides and insecticides.

Zineb, a protective fungicide, is a 75-percent wettable powder. Recommended rate is 2 pounds in 100 gallons. It is effective for the rust diseases and many of the summer diseases on apple such as black rot, sooty blotch, and fly speck. Zineb plus captan, each at half strength, is one of the most popular apple orchard fungicides. Since Zineb is compatible with all orchard chemicals, it may be used almost without discretion in the apply spray schedule.

INSECTICIDES AND ACARICIDES

Package labels are a most valuable source of information about insecticides and acaricides. These labels must be read before using the materials in the package.

Carbamate Insecticide

Sevin. Effectiveness against a wide range of insects and low use hazard make sevin a valuable tool for fruit pest control. One pound of 50-percent wettable powder in 100 gallons of water has been controlling codling moth and green apple aphid. Two pounds are usually required for plum curculio, tarnished plant bugs, stink bugs, rosy aphids, periodical cicada, red-banded leaf roller, and oriental fruit moth, although 1½ pounds will control small numbers of these pests. Sevin is especially effective against periodical cicada. It may be used alone in a schedule with good results, except that mites will need special attention as they may tend to multiply rapidly. To avoid possible fruit drop of apples, do not apply until 15 days after petal-fall, especially on trees easily thinned.

Chlorinated Hydrocarbons

Acaricides

The following two chemicals are specific for mite control with primary action against mobile mites. Both have low use hazard.

Chlorobenzilate is a medium-lasting chemical for mite control on apples after second cover. Use more than one full-dosage application for all species.

Kelthane, a long-lasting chemical for all-season use, has given excellent control of a wide range of mites. The liquid preparation is most effective.

Insecticides

BHC is a contact and stomach poison suggested primarily for aphid and mite control before bloom.

Dieldrin has high contact and stomach toxicity to insects and is highly persistent. It controls curculio well and is effective for tree borers. Although it kills stink bugs and tarnished plant bugs, its action is slow. Use hazard is moderately high.

DDT has a wide range of effectiveness and use. After long use, codling moths are becoming resistant, but DDT is still effective on tarnished plant bugs and many other pests.

Endrin is similar in chemical composition and action to dieldrin. It is very effective for mice, red-banded leaf roller, and plum curculio. Use hazard is high. A very low dosage will kill fish so avoid spraying in the watershed of a fishing pond. Use on apples only; do not use after first cover. Wettable powder is preferred for tree applications because other formulations may cause fruit russet.

Methoxychlor is similar to DDT and is effective on many of the same insects, but to a slightly less degree. Methoxychlor also controls plum curculio and apple maggot. It usually has to be used at a higher rate than DDT but it may be used closer to harvest. It is suggested for late-season use as a wettable powder.

TDE is used primarily for control of leaf rollers and is still among the most effective materials for this purpose although some resistance seems to be developing.

Dinitro Compounds

DN 289 or Elgetol 318, Elgetol, and DNDry Mix Number 1 are dinitro compounds to be used during the dormant period for killing aphid eggs and scale insects. They may also kill 60 to 95 percent of European red mite eggs. To avoid damage these compounds must be used before the buds break. Other materials are available for the same pests during the pink or later stages.

Petroleum Oils

More highly refined oils are available now than in the past. Read and follow the label carefully. Dosage is usually 2 to 3 gallons in 100 gallons of water. Oils may be applied later than the dinitros, or as late as silver tip or delayed dormant stages. Combinations of oil and phosphorus-based materials such as Ethion and Trithion have effectively controlled aphids, European red mites, and scale insects. New oils are being developed for use on foliage.

Phosphorus-Based Chemicals — (Organic Phosphates)

Although a wide range of characteristics is associated with this group of chemicals, they are all hazardous to handle because they are highly toxic and can penetrate the skin rapidly. Resistance to them has developed quickly, especially among mites. Little is known about the mechanism of resistance, but mites seem to become resistant to a new phosphate sooner if they are already resistant to another phosphate. Except for long-lasting chemicals, phosphates should be used in several applications at short intervals for mite control. Phosphates

may be used against insects that can be killed while they are in the dormant stage.

Demeton (Systox) is a systemic chemical — that is, it is absorbed by plant tissues. It gives very good control of aphids and mites on apples. Two applications about 7 days apart — each from a different side of the tree — are effective if done before the leaves harden off during the summer. After that, the material is not absorbed well. No more than three applications should be made in one season. Use hazard is high.

Diazinon is effective against a wide range of insects. It will not stop high populations of red-banded leaf rollers or mites, but it suppresses both. It is good against codling moth, aphids, and apple maggot. The use hazard is moderate; effects are moderately long-lasting. Diazinon is suggested for late-season use in cover sprays. It may cause russet if it is used on young fruit.

Ethion, when used with oil in the delayed dormant spray, will effectively control aphids, mites, and scale insects. Ethion alone has a moderate use hazard, but oil increases the danger of skin absorption. Ethion is moderately long-lasting.

EPN is similar in action to parathion. It is more effective than parathion for mites but slightly less effective on insects. Use hazard is high. EPN is suggested as a possible replacement for parathion during late season on apples and peaches.

Guthion has given exceptionally effective control of most pests on apples and peaches. Use hazard is moderately high, but no plant injury has been reported. Effects are moderately long-lasting. Wettable powder is suggested for early-season use. Do not make more than eight applications in a season. For exceptionally high populations of red-banded leaf rollers or rosy apple aphids, use in the pink. To control mites, use at least three consecutive applications at about 7-day intervals; inclusion of guthion in cover sprays is especially valuable for spotted mite control. Guthion acts too slowly to prevent catfacing on peaches by tarnished plant bug.

Malathion effectively controls a wide range of insect pests, being especially good against aphids; and is also effective when first used against mites. It will not control high populations of curculio or red-banded leaf roller. Since the effects are short-lasting, it may be used close to harvest. Use hazard is low.

Parathion has been effective on a wide range of insects. It has also given good mite control, but mites are generally resistant where

it has been used for several years. Effects are moderately short-lasting; use hazard is high. Parathion may cause russet when used on apples early in the season.

Phosdrin is a very short-lasting, systemic chemical which also kills by contact. It is especially useful when high populations of insects and mites need to be killed immediately and when control is necessary close before harvest. It is very effective against red-banded leaf roller. Use hazard is high.

TEPP is effective for aphids and mites, but is very short-lasting and has a high use hazard.

Trithion is a long-lasting aphicide and acaricide, and is also moderately effective against scale and codling moth. It can be used with oil in the dormant period. During the growing season it may cause leaf burn on very young leaves, especially when drying conditions are poor. Little damage has been experienced in summer during good drying conditions. Use hazard is moderate.

Sulfur-Based Acaricides

Aramite gives medium-length control during hot weather, but now has zero tolerance on fruit at harvest. Any reserve supply may be used after harvest on early varieties to prevent high overwintering egg population, or on non-bearing trees if needed.

Chlorbenside (Mitox) in the pink spray has given excellent, long-lasting control of European red mite. This material, as well as Genite and Tedion, is also effective against the egg stage of all mites. Thorough wetting of the trees will give best results. For good coverage and therefore good control, a rate ½ to ¾ of that recommended on the label is suggested in the prepink and pink sprays. A higher rate should be used when eggs are very numerous.

Genite is long lasting, either as a wettable powder or an emulsifiable concentrate. Used in the pink, it gives excellent control of European red mite. (For its use against the egg stage, see "chlorbenside.")

Ovex is specific for eggs, thus it must be used in two or more consecutive applications. It effectively controls all species on fruit trees. Ovex is similar to Chlorbenside, so the two should not be used successively.

Tedion is a long-lasting chemical for use in the pink spray. It has given excellent control of European red mite. Like chlorbenside (see above) it is effective against the egg stage.

(Orchardists will find this kind of spray record very useful.)

RECORD OF MY APPLE SPRAY SCHEDULE 196__

SPRAY	Started (date)	Finished (date)	Total gals. or tanks	Materials used or other remarks
Dormant				
Prepink				
Pink				
Bloom				
Calyx				
Calyx top-off				
COVER				
First				
Second				
Third				
Fourth				
Fifth				
Sixth				
Sixth top-off				
SECOND BROOD				
First				
Second				
Third				
Fourth				

RECORD OF MY PEACH SPRAY OR DUST SCHEDULE 196__

SPRAY or DUST	Started (date)	Finished (date)	Wind direc-tion	Amount of material used	Materials used or other remarks
Dormant					
Prebloom					
Bloom					
Shuck-split					
COVER First					
Second					
Third					
Fourth					
Fifth					
Sixth					
Seventh					
Eighth					
Ninth					
Tenth					
Eleventh					

COMPATABILITY CHART OF ORCHARD CHEMICALS

Elemental sulfur, lead arsenate, dieldrin																											
Lime-sulfur	X																										
Fixed copper	X	N																									
Bordeaux	X	N	X																								
Mercuries	X	N	?	?																							
Lime	X	X	X	X	?																						
Niacide M	X	?	?	?	X	N																					
Captan, Phaltan	X	N	N	N	X	N	X																				
Zineb, ziram	X	?	?	?	X	N	X	X																			
Ferbam, thiram	X	?	?	N	X	N	X	X	X																		
Dichlone	X	?	?	?	X	?	X	X	X	X																	
Glyodin, Glyoxide	X	X	X	X	X	X	X	X	X	X	X																
Parathion, EPN 300	X	0	0	0	?	0	X	X	X	X	X	X															
DDT, DDD, TDE, chlordane, endrin	X	?	X	X	X	0	X	X	X	X	X	X	X														
Malathion, Trithion	X	0	0	0	?	0	X	X	X	X	X	X	X	X													
Demeton	X	?	?	?	?	0	X	X	X	X	X	X	X	X	X												
Guthion, diazinon	X	?	?	?	X	N	X	X	X	X	X	X	X	X	X	X											
Sevin	X	N	X	N	N	N	?	X	X	X	X	X	X	X	X	X	X										
Methoxychlor	X	?	X	X	X	?	X	X	X	X	X	X	X	X	X	X	X	X									
BHC (lindane)	X	N	N	N	X	N	X	X	X	X	X	X	X	X	X	X	X	X	X								
Kelthane, aramite	X	N	N	N	X	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X							
Ovex, Genite, chlorbenside	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Chlorobenzilate	X	?	N	N	X	N	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
Tedion	X	X	?	?	X	?	X	X	?	X	?	?	X	X	X	?	X	?	X	X	?	?	?				
Karathane	X	?	?	?	X	?	X	X	X	X	X	X	X	X	?	X	X	X	X	X	X	X	X	X			
Streptomycin	X	X	X	X	X	X	X	X	X	X	X	N	X	X	X	X	X	X	X	N	X	X	?	?	X		
Dodine (Cyprex)	X	N	?	N	?	N	X	X	X	X	X	X	X	X	X	X	X	X	X	?	X	X	?	N	X	X	
Oil emulsion	N	N	X	X	?	X	X	N	X	X	N	?	N	N	N	?	?	?	N	N	?	?	?	?	?	N	N

Key to Symbols

X = materials compatible
N = materials not compatible
? = questionable
0 = decomposes on standing; that is, residual action is reduced

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